Developing crisis training software for local governments – from user needs to generic requirements

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Abstract

In this paper we analyze and present the generic requirements identified for a software aiming at supporting crisis management training in local governments. The generic requirements are divided into overall requirements, requirements connected to the trainer's role and requirements connected to the trainee's role. Moreover, the requirements are mapped to problems as well as opportunities. Finally, we present examples of elaborations of the addressed requirements based on software design considerations. In our work we applied a design science approach and the artifact presented in this paper is a list of generic requirement. The presented requirements and the systems development process used, provide guidelines for systems analysts and developers in future systems development projects aiming at constructing new software for crisis management training.
Keywords Crisis Training, Crisis Exercises, Design Science Research, Requirements Engineering, Needs Analysis

1. Introduction

Although vital to any society, the digitalization of crisis management in general and of crisis training in particular is still in its early stages. Natural disasters and refugee streams are two examples of crises that are expected to increase in the future. This is adding to the wide range of risks that local and regional governments already are facing. An important part of crisis preparedness is to arrange crisis training, here referred to as both preparations for individual roles and collaborative exercises. Crisis exercises are traditionally performed by gathering personnel ("trainees") from different organizations (municipalities, police, fire department, healthcare etc.) to "solve" a fictive crisis scenario. There are several exercise methods such as table-top discussions, functional exercises or field exercises (cf. [25]). The traditional methods are often resource-demanding, time-consuming for the participants (trainees) as well as complex to plan for the trainers (often a security coordinator) (cf. [10]). This is especially the case in smaller municipalities with limited personnel for crisis preparedness.

Computer based training has been suggested to offer resource-efficient and flexible complement to the traditional time-and-space-dependent training (e.g. [16]). However, an earlier study has found few examples of ongoing usage of these systems [18], perhaps indicating that their spread are limited. One potential explanation is that the systems fail in information or system quality. Despite many examples of design specification of computer-based training systems, there are only a few earlier studies that present need elicitation, objectives and requirements specification for the software [18], leaving little guidance for the design of forthcoming solutions. In this paper we report on the requirement elicitation in a research and development (R&D) project aiming at developing a generic tool for crisis management training in local and regional governments. A design science research (DSR) approach was applied, and in this paper we seek to answer the following question: *What are the (generic) requirements of software aiming at supporting crisis management training in local governments?* Next we describe the research setting of the R&D project, followed by related work. The research method is elaborated in section 4, and the results from the requirement engineering process are presented in section 5. The paper ends with conclusions and suggestions for further research.

2. Research Setting

The research was primarily performed in the Swedish-Norwegian multidisciplinary R&D project Preparing for Future Crisis Management (short name CriseIT). The project, financed by EU/Interreg Sweden-Norway program, runs between 2016-2018. The collaboration and preparation for the project started a couple of years earlier. Also, some members of the Swedish project group had conducted two smaller projects in the same problem area during 2013-2015. The purpose, goals and project group of the current project were therefore influenced by the results from the earlier projects. Also, three of the interviews used as empirical data in this study took place in 2015. The aim of the CriseIT project is to develop networks, knowledge, methods and ICT tools that enable cheaper, easier, more efficient and effective crisis training thereby lowering border-region barriers for good crisis preparedness. All of the authors participate in the project. The partnership is of quadruple helix model, including sixteen organizations among which there are two universities with three disciplines, three businesses, as well as national, regional and local government agencies and also Non-Government Organizations (NGOs).

3. Related work

The area of crisis management training is presented and then follows a review of studies on IS in crisis (disaster, emergency) management training.

3.1. Crisis Management Training

During a major crisis or disaster, the strategic level has a vital role in identifying, and prioritizing the critical actions the organization needs to take and communicating these to lower levels (e.g. [8]). Decisions are mainly unstructured at this level, and the stressful situation of a crisis adds to the complexity of the tasks. Furthermore, as few crises reach this severity, there are few opportunities for the strategic level to get practical experience. Individual crisis training for the role and collaborative exercises are therefore important to increase preparedness. Sinclair et al. [31] claim that “the fact that disasters are infrequent makes training and exercises especially important in emergency management” (p. 508). Exercises permit testing of the disaster plan and the adequacy of training of personnel, as well as providing “hands on” checks of communication tools [25]. Moreover, exercises can test the viability of the response network and hopefully reassure the citizens that the authorities are prepared for crises [25].

Before an exercise method and scenario are chosen, the purpose (*why*) of the exercise and its goals (*what*) need be a defined, as noted in many national crisis training guidelines (e.g., [21]).

Bharosa et al. [7] stress the importance of coordination in disaster management. As a result, crisis exercises need to involve a number of actors to prepare for coordination in crises event.

Another challenge is that local governments with their limited budgets have the primary responsibility both for handling real crisis events and preparing for them. In smaller municipalities a single emergency coordinator may have the sole responsibility for planning, and sometimes also performing, crisis training in the organization [20].

3.2. Information Systems in Crisis Management Training

Computer-based crisis training could offer a resource-effective complement to traditional training (cf. [16]). Nikolai et al. [23] acknowledge a number of advantages with computer-based (simulation) training:

[...]simulation-based training allows emergency managers to train new personnel without being in the middle of a disaster. Moreover, simulation-based training allows personnel to train more frequently than they otherwise would be able to in live and face-to-face exercises. In addition, they enable distributed access to data, resources, communication, and even the training itself. Computer simulations also enable teams to train selective portions of the emergency management hierarchy. Finally, whereas feedback has delays in non-computer solutions, feedback can be immediate in a computer-based simulation system.

However, Ahmad et al. [1] claimed in 2012 that IT usage for crisis training was still in its infancy. A few years later, Magnusson and Öberg [18] concluded from their literature review that reports in the research literature on ongoing usage of computer-supported training were still rare. In the wake of the ongoing digitalization and the growing importance of crisis preparedness due to global warming, this is somewhat surprising.

The lack of reports on usage does not seem to stem from a lack of IT solutions. There are several studies reporting on computer-based software for crisis training. Pottebaum et al. [27] (p. 383), for example, present a taxonomy of IT support for training exercises constructed from "a thorough analysis of available commercial IT systems, demonstrators and concepts from research projects and use cases derived from stakeholders and context analysis". The taxonomy has a trainer's perspective and phase-driven approach. According to Pottebaum et al.'s taxonomy [27], there are IT-systems for planning, controlling, observing, and debriefing during an exercise. Magnusson and Öberg [18], however, claim that earlier studies mainly concern systems supporting the execution of training/exercise (and not planning or after-action tasks). Magnusson and Öberg [18] also conclude that design specifications of existing or proposed systems dominate in research while few studies report on usage or regular tests of systems.

Computer-based crisis training may be individual or collaborative [3], distributed or co-located [17] and support different exercise methods. Our literature review found numerous examples of studies on systems for simulations (e.g. [1], [8], [15], [17]), while studies focusing on IT support for tabletop exercises seem to be rare. An exception is Araz et al. [4] that report on a tabletop exercise where video clips, digital maps and interactive simulation tools were used to enrichen traditional tabletop exercises. Moreover, Asproth et al. [5] present a study where a web-based system for "tabletop like" collaborative exercises was tried out in two exercises – one co-located and one distributed – to study if it could serve as an exercise platform and an evaluation tool. They conclude that the results were promising. A web-based system enables usage from different platforms and locations [5].

Another possible explanation for what seems to be a limited adoption of software for crisis training, except for technology resistance as indicated by MacKinnon and Bacon [17], may be that the systems on the market simply fail to meet the needs and prerequisites of the target groups. Magnusson and Öberg [18] found few explicit studies of user needs in their literature review of computer-based crisis training. They conclude: "It is thus not clear from our literature review which (generic) user needs these systems were developed to meet". However, there are a few studies that discuss development methods and requirements (e.g. [16]), or the need for standardization in components information models and data interfaces [15]. Furthermore, Nikolai et al. [23] call for the ability to share exercises and simulations in a standardized way. Other identified desirable features are: *logging of exercise data* for analysis, reflection or evaluation and the a*bility to enter new events or changes* to a scenario [6], [27], [29]. Also,

Greitzer et al. [12] (p. 4) suggest a number of design guidelines to promote active learning in training applications. One such guideline is to manage the learner's cognitive load by *organizing material into small chunks* and *gradually increasing complexity*. However, all in all, we have not been able to identify any earlier studies that describe the entire development process from business needs to requirement elicitation and a validated system. Another interesting study is Reuter et al. [30], which lists modules and functionality in a prototype for a collaborative-exercise system. The modules seem generic enough to be useful in the design also by other crisis training systems. Reuter et al. [30] also describe their development process.

4. Method

The overall research approach used in this study can be described as design science research (DSR) (e.g. [9], [13], [14]). In DSR the result is always an artefact, more precisely described by Hevner et al. [14] as follows: "IT artifacts are broadly defined as *constructs* (vocabulary and symbols), *models* (abstractions and representations), *methods* (algorithms and practices), and *instantiations* (implemented and prototype systems)" (p. 77). The relevance of an IS artifact depends on the problems and opportunities, i.e. the business needs for a new IS, in the application domain (cf. [9], [13], [24]). A first step is thus to identify these.

Components of methods for change analysis [11] and work system analysis [2] were utilized to identify, analyze, and describe problems and opportunities in our project. This involved mapping organizations and people involved in planning and performing exercises, organizational strategies and processes as well as use of technology etc. (cf. [13]). Examples of artifacts that could support this step are (static) snapshots of the work system [2], problem or goal diagrams [11] and business process models. However, only goal lists and problem lists were used for evaluation with the target group. The reason for this was that the time required for introducing and performing joint modelling was not considered possible to acquire from the practitioners. After having identified problems and opportunities, the next step was to define objectives or (meta-)requirement for the solution (cf. [9], [24]). In this paper we strive to identify generic requirements, i.e. generic issues that a (groupware) designer of collaborative crisis training systems should consider when designing a system (cf. [19]). Several iterations following the seven guidelines of DSR [14] were conducted to reach the list of generic requirements presented in section 6.

4.1. Elicitation, data collection, and continuous evaluation

Several requirements elicitation methods such as interviews, screen sharing prototyping activities, workshops, walkthroughs as well as evaluations "in the wild" were used during the data collection phase (see Table 1).

Table 1. Requirements engineering methods during the project

Method / Technique	**Purpose**	**Stage in the Project Cycle**	**Data Collection Method**
Background interviews	Collecting data related to the needs and expectations of the users; project aim, outcomes, participation etc.	Early	Sound recording and note-taking
Screen sharing prototyping activities	Collecting data related to users' needs and expectations related to the prototype and final artifact	Early	Screen recording with voice and the GUIs
Sequence of work interviews	Collecting data related to the business process/sequence of work tasks to be performed with the artifact	Early	Sound recording and note-taking

Workshop(s)	Identifying problems, needs and objectives and later collecting general systems requirements from project stakeholders. Evaluation of the project up to now. Evaluation and validation of requirements. Future heading. Validation of progress this far.	Early-Mid	Note-taking, power point files, google docs
Walkthrough(s)	Evaluation and validation of the artifact (prototype) and requirements.	Mid	Written summaries afterwards
Pilot field testing	Evaluation of the developed artifact when used in natural environment by expected end-users. Collection of proposed changes. Validation of the progress this far.	Late	Trainees' input during the sessions, trainees' written evaluation of the system when finishing the exercise, workshop discussions with written summaries

Due to the nature of the present study, with stakeholders separated by long distance, different data collection methods were employed in different cases.

Nineteen qualitative and semi-structured interviews were used to gain an initial foundation regarding the objectives, requirements and expectations for the project, such as project aim, project outcomes and degree of participation. Interviews were also held to gain an initial knowledge of the business processes/workflows. The interviews were held in 2015 (3) and in 2016 (16). All of the respondents were active in planning and/or performing crisis management training at different levels of government, or in companies and NGOs. All but one interview were recorded and transcribed. Seven interviews were performed by a video conference system or telephone, and the rest face-to-face. On the respondents' requests two interviews included two and three participants respectively. The interview questions concerned, for example, the situation as-is regarding training methods, frequency of training, problems, IT usage, and attitudes towards IT based training.

During the study, several workshops took place. In a participatory design sense, workshops "are often held to help diverse parties ("interested parties" or "stakeholders") communicate and commit to shared goals, strategies, and outcomes (e.g. analyses, designs, and evaluations, as well as workplace-change objectives" [22] (p. 20). Some of the early workshops were assigned to identify problems and opportunities. Later the workshops served to evaluate and refine the problems and objectives in an iterative process.

In total, 17 screen sharing prototyping sessions were conducted. The first ten sessions were carried out during April – May in 2016. The last seven sessions were carried out during autumn of 2016. As for the interviews, all respondents were active in planning and/or performing crisis management exercises at different levels of government, companies or in NGOs. All interviews were held with the aid of the web collaboration tool Ozlab, developed at Karlstad University. For oral communication some kind of communication tool like Skype were used. All sessions were recorded, both screen and audio. During the first ten interviews the interviewees were presented to fairly empty mockup (content wise). During the last seven interviews the interviewees were presented to more complete mockup. During the sessions the interviewees were asked to "suggest contents in addition to what had been jointly defined in workshops, or to comment on existing content including interaction design" [26] (p.156).

For mainly budgetary reasons, the implementations were later conceived to be in WordPress. The project had already a WordPress site for smaller individual education on definitions of various complex concepts. Therefore, also the tool for conducting collaboration exercises was thought to be implementable in WordPress. As WordPress provides the means to *edit* sites published with it, the parts for constructing the collaboration exercises have now (partly) been developed in WordPress.

Walkthrough is one kind of expert evaluation [28]. In our study, domain experts, together with the designer/facilitator "walk through" a specific (or complete) part of the prototype. The

purpose of this technique was twofold: First the designer got the chance to validate and evaluate the prototype to ensure compliance with the requirement specification. Second, new requirements could arise. In contrast to screen sharing prototyping based on mock-ups, such requirements could take a little longer to implement, and sometimes cost vs. benefit balancing had to be made.

Before the field testing some key users took part in a series of walkthroughs, where they acted as "exercise managers" and created the exercises to be tested in the pilot field tests. These pilots were small, sometimes with rescue service staff, sometimes mixed with researchers and professionals. In order for everyone involved to understand problems connected with building an exercise as well as problems connected with being a participant in an exercise, the roles were shifted through these pilots, and one pilot was carried out with people not involved in the project.

As noted, the walkthroughs constitute in themselves a kind of evaluation, as feedback from stakeholders was immediate even if all suggestions could not be accommodated. Workshops and requirements lists also accompanied the walkthroughs and pilot field tests.

5. Results

The resulting requirements are here sorted into three categories: overall, trainers, and trainees. We start by presenting the problems and opportunities found in interviews and early workshops.

5.1 Grounding in interviews and early workshops

We present the problems and opportunities in current crisis training practices that were most frequently mentioned and/or considered to be most important by the stakeholders. Problem (P) and opportunities (O) are numbered to ensure traceability to requirements later in the chapter

Problems

A frequently mentioned problem in interviews and workshops were that *too few exercises* (P1) took place. Almost all of the respondents in the nineteen interviews believed that their organizations did not carry out enough exercises and *few organizations carried out any training* (P2) for the individual role. Some of the respondents referred to specific problems such as *failing to involve relevant internal and external actors* (P3), or *lacking particular types of exercises* (P4), but there was also a desire to train/exercise more in general. Among the problems that result in few exercises were *time-consuming and complex planning* (P5). Constructing a scenario takes time, as does finding a date that suits all or most of the intended trainees. Also, most organizations had *scarce resources* (P6) in budget and personnel (e.g. security coordinators) for planning. Some of the organizations even lacked a dedicated role responsible for planning training. Furthermore, the trainers/security coordinators found it *difficult to design exercises that are realistic, varied, and provides learning* for all trainees (P7). Some also mentioned the problem of "*having to invent the wheel" every time* (P8) a new exercise was planned and as a result of that most of the organizations were *lacking dedicated IT support* (P9) for exercise planning (and execution). At the same time, several trainers/security coordinators claimed they were *lacking a structured approach for planning* (P10) where the purpose and goal of an exercise was defined first, as recommended by the national authority.

Exercises were also time-consuming for the trainees (P11) as they often needed to devote somewhere between half a day to 24 hours or more, and in rural areas sometimes a need to travel long distances (P12). This is problematic as participants at the strategic level tend to have busy agendas. Furthermore, keeping up the organizational knowledge in-between exercises (P13) was seen as problematic as was employee turnover (P14) as it severely impacted on P13.

Opportunities

Two primary target groups were identified by the respondents: the strategic level/crisis management team (as trainees) and the security/emergency/safety coordinators (as trainers). Several opportunities with IT-supported training were identified for these two groups. IT-supported training/exercises were thought to enable *more frequent exercises* (O1), in *short sessions* (O2) and with *more actors/trainees* (O3). Also, digitalization was considered to allow high *flexibility* (O4) such as both *asynchronous and synchronous* (O5) exercises and *distributed exercises* (O6) with participants at different locations. The latter would enable participants to take part in training/exercise from their regular workplace or "on the go" using either a *computer, tablet or smartphone* (O7). Moreover, IT was believed to contribute to *simplified, and more structured planning* (O8) and to be able to *provide a holistic process* (O9) from training needs to (implemented) improvements. Furthermore, several saw great potential in being able to *collaborate and reuse exercise/training* (O10) planning and content between organizations. Another opportunity that was mentioned was automatic logging to get *richer data from exercises/training* (O11) (e.g. who participated, the discussions underpinning decisions etc.). Yet other opportunities identified were *better overview* (O12) of an ongoing exercise, for both trainers and trainees, and the ability to *use multimedia* (O13) to "color" a scenario and make the training/exercise more fun or realistic.

Moreover, IT was seen as having potential to *enrichen traditional exercises* (O14), and also to *support individual training* (O15). In addition, IT was considered as enabling *role based access* and *adaptation of content* (O16) to functions, roles or even individual training needs.

5.2 Initial Requirements

Need analysis of problems and opportunities was utilized as a starting point for discussing the (initial) requirements or objectives (cf. [24]) of the system to be built. The initial sets of requirements identified in the spring of 2016 are presented in Table 2.

Table 2. Requirements derived from interviews and workshops

No	Requirement	Problems and Opportunities	Early Design Choices
Overall			
R1	Support in the entire process from planning, invitation, execution, and evaluation to bringing back identified needs for improvement to the organization	P5, P9, P10, P13, P14, O9	Web-based system (as it will be accessible to all involved in all stages)
R2	Enable inter-organizational (and cross-sector) exercises	P3, P9, O3	Open web based solution
R3	Mobile access	P11, O3, O4, O6, O7	Responsive design
R4	Low cost	P5, P6, P9	Free access, user organizations set up instances of exercise and user accounts, table-top exercises (no simulations/virtual environments)
R5	Role-based system	P6, O16	
R6	Timeline of exercise/events	O8, O12	(Prototype dependent)

R7	Support short, module-based exercises	P5, P11, O2	
Requirements connected to trainers' role			
R8	Enable reuse, and collaboration in planning, of exercises	P5, P6, P7, P8, O10	Copy function included in planning view
R9	Support trainer's overview of, and intervention in, an ongoing exercise	P7, P10, O12	Progress report aligned to timeline (R6)
R10	Support both collaborative exercises and individual training	P1, P2, P3, P4 , O1, O3, O14, O15	Two separate systems
R11	Support both synchronous and asynchronous exercises	P5, P11, O4, O5	
R12	Support knowledge progression	P7, O16	
R13	Logging of training/exercise data incl. participants and their "results"	P7, O11	
R14	Ordered planning process for quality checking	P10, O8, O9	Enter goals and indicators when creating a new exercise module
R15	Possible to send out invitations to an exercise	P9, O9	
Requirements connected to trainees' role			
R16	Accessible independent of platform	P12, O4, O6, O7	Responsive web
R17	Ease-of-use	P3, P11, O1, O3, O15	
R18	Support Multimedia content	P3, O13	Web supports multimedia content
R19	Possible to pause, repeat/replay an exercise	O2, O4	
R20	Flexible	P11, P12, O4	(Asynchronous and distributed)

5.3 Elaboration of requirements

The initial requirements were further elaborated (refined or redefined) (see Table 3) through co-design activities on distance with some limited interactivity and a year later – after the selection of a CMS publishing system (WordPress) to base the prototyping on rather than developing the tool from scratch – through pilot trials in which exercise modules were built and then ran for a few days according to the stakeholders' idea of suitable pace for asynchronous but collaborative exercises.

Prototyping can lead to specification that makes software easy to use but may contain very specific solutions that are dependent on the system emerging. We try here to highlight emerging requirements that can qualify as generic aspects of a tool for defining and executing exercises.

R1, R8: Purposes and goals of an exercise is important to define in order to plan it, but also to evaluate it to determine whether or not further exercise should be conducted to develop the same skills. In the share-screen prototyping sessions, some participants mentioned the risk of incoherent classification schemes. They knew of shared file systems where each user could set their own classification terms, which had resulted in guesswork of how other people had classified documents. How exercise modules should be classified, not only according to the general skills as seen by the national coordinating bodies, but also to support the work of local rescue services when they assist organizations on the local level, was not solved in the prototyping sessions. However, they clearly pointed to the necessity of defining and maintaining a process required to trim the classification schemes.

Furthermore, as concerns R1, prototyping showed that indicators for goal measurement have to be simple to state.

R17: The two primary target groups defined above would typically have very different views on the functions of the tool. The trainers would build exercise modules and also oversee the exercises when these are run. The other group, the trainees, would typically only login to participate in a collaborative exercise. In the first prototyping phase, it was deemed necessary for the trainers to use computers to define ("build") exercises. Later on, it was found that trainers also need to see the exercise from the future participants' view, especially the view provided by a small screen device.

The second phase, when WordPress had been selected, gave further insights into the requirements. WordPress has a preview function, and any publisher (here, trainers who publish exercise modules) can use a second web browser to check their web sites while they are making changes. However, this is perhaps not so obvious for our stakeholders, especially if it has to be done on another device (namely a mobile phone).

R11: In the second phase, modularization (R7) appeared as a very important requirement. As it was hard for the experts on collaborative crisis training to actually foresee how an exercise would flow in a real asynchronous and distributed environment, they downsized their ambitions and agreed that this tool (prototype, admittedly) should primarily be used for very short sprints. For instance, even if it was envisioned that trainees would spend only 10 minutes per session, it turned out that they spent half an hour sometimes as they would like to read what other trainees had written since last time they were logged in.

R6: This also lessened the graphic requirements of using a timeline even if this is the standard procedure for developing an exercise scenario and also communicating it. The shorter and more specific tasks or subtasks in focus for a certain exercise, the less demanding the presentation requirements are. In the second phase, the WordPress (blog) posts could possibly suffice; in this project we used a plug-in called *LearnPress* from ThimPress where each task (or bundle of tasks) was put in a "lesson". These are accordions that open when the user wants. The trainer composing the exercise can keep them open in order to have an overview.

Table 3. Examples of elaborations

Req.	**Requirement**	**Problems and Opportunities**	**Design Choice**
R17a	Preview of the trainees' views when building a new exercise module	Trainers need support in their design roles	Prototype-dependent but for CMS the trainer needs to be familiar with web editing
R6a	Overview of the whole exercise process	Trainers commonly use timelines with callouts; not suitable for simple web design	Exercise with few steps may suffice with accordion design
R8a	Support search function for easy reuse of exercises within and between rescue organizations		(Maintenance process needed)

R11a	Guide trainers to design short (=few steps) exercises	Many steps in an exercise makes it hard to managed asynchronous processes	This is a pedagogical awareness that trainers need to have and not that the tool itself should limit the number of submodules
R11b	Possible to time set modules in an exercise		Submodules are made visible according to a time scheme
R1a	Entering/selecting quality planning parameters (goals and indicators) must be easy	Indicators are probably written in evaluations of some earlier exercise; it will take time before these are integrated in a digital tool. Goal setting must be easy in order to support an easy definition of new exercises	Simple text boxes to fill in; no automatic prompts to evaluate individual indicators as exercises must be narrowly targeted and thus easy to evaluate. This reduces entry cost for new trainers.

Reflection on the iterative development process and stakeholders' participation

When the WordPress version was ready for demonstration to the trainer category of our stakeholders, it was agreed that one local safety coordinator should use it as a follow-up exercise for city council members who had participated in a county level exercise after which they felt the need to train more on one specific collaborative task. After an initial walkthrough by one of the IS researchers, the coordinator continued planning the exercise but was gravely disappointed. It was hard to work with the tool and the coordinator had the feeling that the busy city council people would be annoyed with a clumsy IT tool. This attempt to plan an exercise gave a lot of feedback, but also reason to question our process: the developers should have assisted the local coordinator more in the initial steps. Also, proceeding quickly to a real field test left this person critical of the impression the prototype would make. The plans changed to several pilot tests with researchers and trainers on both sides, and only a limited field test with people outside the project (we classified also this as a "pilot test" in the Method section).

6. Conclusions and discussion

In this study we strive to answer: *What are the (generic) requirements of software aiming at supporting crisis management training in local governments?*

From our need analysis and later requirement elicitation we have identified a set of generic requirements or issues that we believe are valuable to consider for any designer of information systems for crisis management training in local government:

- *Support the entire training/exercise process* from planning to execution and evaluation of training/exercise to follow-up of identified improvements
- *Support multi-actor collaboration/exercises and single user training* as real life events demand a number of collaborating actors while requiring each participant to have good knowledge of their individual responsibilities
- *Provide synchronous and asynchronous exercises*
- *Support co-located and distributed training/exercises*
- *Support reuse/copying of exercises/training* content
- *Provide functionality for searching* for existing exercises/training
- *Support built-in-control* e.g. to ensure that purpose and goals are defined before the scenario in the planning process, or ensure that the trainer can intervene in or change the content of an ongoing exercise
- *Provide easy overview*, e.g. of the entire exercise with its modules and steps as well of how many and who have participated in different exercises/training

- *Support module-based training/exercises*
- *Support low costs* as the resources are limited in most tax funded organizations
- *Provide easy access and low entry barriers*
- *Support a wide range of interaction methods, multimedia and data formats* for import/export – to increase "the fun factor" and facilitate integration with other IS
- *Support role based content* to enable custom made content/assignments that "mirror" real life organization of crisis management teams
- *Support logging of exercise/user data* to support trainers' monitoring and evaluation of an exercise/training session and to support analysis of organizational preparedness

Furthermore, by making very small chunk modules that fit into other demanding tasks during a workday, we indicate the requirements that pertain to the organizations adopting this tool, such as familiarizing themselves with asynchronous exercises both as concerns planning as well as participating in them. Establishing inter-organizational training databases is a promising goal but blending national training standards, local needs and organizational terminologies still requires a great deal of collaboration – which indeed such tools will pave the way for if opened up to multi-actor collaboration, which is desired for effective crisis management.

While more studies are needed to confirm these requirements, we believe them to be valuable as a starting point for system analysts and developers as well as practitioners purchasing software for crisis management training. The novelty of the study lies not so much in the individual requirements as in the compiled list and the detailed description of the requirement elicitation process. The latter may serve as inspiration for early phases in future DSR projects.

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